Prioritisation of animal welfare issues in the UK using expert consensus

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ORIGINAL RESEARCH

Prioritisation of animal welfare issues in the UK using expert consensus

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Abstract

Background The welfare of all animals under human management is an area of consistent public concern, but strategies to improve welfare may vary across species. In this study, expert consensus, using a modified Delphi approach, was used to prioritise welfare issues of farmed and companion animals in the UK.

Methods The study involved 117 experts, divided between eight species groups. Experts were recruited from a broad range of disciplines. Two rounds of online surveys were conducted using the online survey tool, and the final round was an in-person workshop with a subsection of experts (n=21). The experts agreed that welfare issues should be ranked considering three categories: (1) severity, (2) duration and (3) perceived prevalence.

Results A comprehensive list of welfare issues was generated for each species by discussion boards (cats, rabbits and horses) or by literature review (dogs, pigs, poultry, cattle and small ruminants). In the first online survey, the experts scored each welfare issue using the three categories (severity, duration and prevalence) on a 6-point Likert scale, where 1=never/none and 6=always/high. Lists of welfare issues were reduced to 25 per cent–59 per cent of the total number, by determining mean ranks from expert ratings. In round 2, experts were asked whether they agreed or disagreed with the rankings. In the final stage, during the workshop, the top-ranking welfare issues for animals were determined for individual animals (considering the greatest severity and duration, in the expert's opinion) and for perceived prevalence.

Conclusions Overall, prioritised welfare issues included lack of knowledge of welfare needs, social behaviour issues, problem behaviours, inappropriate diet and environment, lack of veterinary care, consequences from breeding decisions, poor pain management, delayed euthanasia and chronic ill health. The Delphi process resulted in consensus on the most significant welfare challenges of animals in the UK and can help to guide future research and education priority decisions.

Introduction

Historically, animal welfare concerns were directed primarily at farmed livestock, following significant unease at the intensification and confinement of animals in the 1960s (eg, the publication of *Animal Machines:* by Ruth Harrison in 1964[1]). However, animal welfare remains an area of consistent public concern and these concerns now include all classes of animals where human activities have an influence on animal lives. Improvements in animal welfare may be achieved through legislation or policy changes, education of owners and veterinarians, and through research to understand the issues and the impact of husbandry on animal responses. To address welfare issues, it may be necessary to determine where limited funding resources should be directed to support scientific research, to raise awareness of best practice through knowledge transfer or education initiatives, or to direct attention towards the most pressing issues.

Comparing different welfare issues or different species can be challenging as there are limited objective welfare assessment tools available,[2] and/or limited empirical data. In addition, comparing chronic welfare conditions with acute interventions, even within species, is logistically difficult, and the prevalence of many welfare issues is unknown. In these conditions, using expert opinion can be a useful method to deal with many levels of scientific uncertainty.

Prioritising animal welfare issues should consider the potential cost to the animal. The most pressing welfare

Veterinary Record (2020) doi: 10.1136/vr.105964

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Provenance and peer review Not commissioned; externally peer reviewed.

Received March 30, 2020
Revised May 13, 2020
Accepted May 28, 2020

issues are determined by the severity and duration of suffering, along with the number of animals affected.[3 4] Several studies have used expert consensus techniques to identify and prioritise animal welfare issues, for example, dogs,[5 6] sheep,[7] horses,[8] farm animals,[9] sows[10] and cattle.[11] However, this is the first study to cover a wide range of species (cats, dogs, horses, rabbits, cattle, pigs, poultry and small ruminants). In addition, we also attempted to identify cross-cutting broad welfare issues that affected multiple species.

The aim of this study was to determine the welfare priorities for the most common farm and companion animals (pigs, poultry, cattle, small ruminants, horses, dogs, cats and rabbits) in the UK by expert consensus. To achieve this, we used a modified Delphi method, incorporating a Delphi conference and workshop. Previously, we have reported on the methods to achieve consensus for rabbits, cats and farmed livestock.[12–14] In addition, we also attempted to derive a consensus for two multispecies groups (exotic pets and wildlife), which will be reported separately.

Materials and methods

A full description of the methods has been published[12] and is described briefly here.

Recruitment of experts

A broad range of animal welfare experts were recruited to represent a breadth of opinions and were a combination of practising veterinarians, academics, charity sector employees, industry representatives and policy officials. An expert was defined as someone who had worked in their field of expertise for more than 3 years and was based in the UK.

The recruitment process began by building a database of contacts of well-known experts and used a 'snowball-sampling method' whereby these initial contacts were also asked to refer other experts in their field who would be a good addition to the study. In many instances, contacts were recommended from animal welfare-related organisations, and academics were recommended from UK universities with ethology and animal welfare research groups. Participation was anonymous (except for the workshop) and voluntary.

Welfare issues

For three of the species groups (cats, rabbits and horses), there was insufficient peer-reviewed literature available in order to construct comprehensive lists of welfare issues. For these groups, a 'Delphi conference' was implemented using an online discussion board, as previously described[12 13 15] to generate a list of welfare issues. For these species, experts were given an initial list of issues to which they were invited to discuss, amend and add other issues (anonymously) for 2 weeks. Comments and discussions were collated and a thematic analysis was conducted using NVivo V.11 Pro software and an emergent coding process to derive the overall list of issues for each species. For the remaining five groups (cattle, pigs, poultry, small ruminants and dogs) the peer-reviewed and industry literature were used to create a comprehensive list of welfare issues (as previously described for farmed animals).[14] At the end of each survey, experts were given the opportunity to provide any other issues that they felt might be missing from the original list. It is acknowledged that some issues are linked (lack of knowledge can lead to other welfare issues), and some issues were risk factors and other outcomes. However, these were derived from issues raised by experts and can lead to different methods, and responses to address the issue were retained in the study.

Online questionnaires

Two rounds of surveys were completed anonymously online using the Online Survey tool (formerly Bristol Online Survey, JISC, Bristol, UK) as previously described.[12] Demographic data were collected from the experts (although the provision of this information was voluntary), including year of birth, gender, profession and highest level of education.

In the first round, experts were asked to score each welfare issue considering severity (defined as the likely intensity of the suffering associated with the welfare issue in the opinion of the expert), duration (defined as the likely period of time over which the animal might be expected to suffer from the welfare issue) and perceived prevalence (defined as the estimated proportion of the population of animals likely to be affected by the welfare issue) separately on a 6-point Likert scale, where 1=never/none and 6=always/high. The results of the first survey were reviewed, and only the welfare issues which scored a mean response of 3 or greater (indicating at least some concern for welfare on average) were retained. In round 2, experts were asked whether they agreed or disagreed with the rankings. Where experts did not agree with the relative ranking, they were asked to indicate if they would like to see that issue higher or lower on the ranked lists. Agreement was determined by calculating Fleiss' kappa statistics. Consensus was set at Fleiss' kappa greater than 0.5 or greater than 75 per cent of experts in agreement.

Workshop

The final stage of the process was a workshop held at Edinburgh University in September 2018. Twenty-one animal welfare experts (at least 2 per species group) attended the 2-day workshop, which consisted of a series of small and larger group exercises and discussions in order to finalise the priority welfare lists for each species, using the welfare issues prioritised in round 1 and the agreement achieved in round 2 as guides. The severity and duration of welfare issues were considered together (considering the welfare of

Table 1 Expert demographics averaged over two rounds of surveys, including DOB, gender, profession, level of education, number of years since achieving highest degree

Variable	Cat	Dog	Horse	Rabbit	Cattle	Poultry	Pig	Small ruminant
Number	14	15	19	11	16	12	15	15
Age								
Mean	42	45	45	49	44	44	42	51
Minimum	27	31	35	36	32	36	29	34
Maximum	58	60	71	69	58	63	61	68
Gender								
Male	4	5	2	3	6	*	4	8
Female	10	10	17	8	10	11	11	7
Profession* (%)								
Researcher	12	28	26	23	26	47	31	9
Veterinarian	24	28	8	29	32	21	25	54
Veterinary nurse	9	6	0	0	0	0	0	0
NGO/charity	27	22	28	18	13	21	13	16
Pet trade/breeder	3	0	0	6	0	0	0	0
Industry organisation	3	10	13	0	13	0	13	9
Policy/government	0	0	5	0	3	11	0	6
Behaviourist/trainer	16	6	18	12	0	0	0	0
Other	6	0	2	12	13	0	18	6
Level of education (%)								
None	0	4	4	0	0	0	3	0
A levels/highers	0	8	0	6	0	0	0	11
Bachelor's degree	36	23	30	35	24	6	28	21
Master's degree	14	15	26	18	24	24	21	21
PhD	41	50	26	35	48	64	41	32
Other	9	0	14	6	4	6	7	15

*Note: Experts could select more than one profession if they were, for example, both a veterinarian and worked for an NGO.
NGO, non-government organisation.

individual animals), and prevalence was considered separately (considering the welfare of a population of animals). The experts were asked to create final lists of approximately 10 ranked welfare issues. The final exercise of the workshop, carried out by all participants together, was to determine if similarities or cross-cutting themes existed between the welfare issues determined separately for each species group

During the workshop discussions, the cattle and small ruminant experts considered that dairy goats and dairy cattle could be combined as they experienced similar welfare issues, and sheep and beef cattle were grouped together.

Results

Experts

In total, 117 experts were recruited across species (table 1). The response rates for the first round of online surveys were cats, 86 per cent; horses, 68 per cent; rabbits, 82 per cent; cattle, 75 per cent; pigs, 93 per cent; poultry, 75 per cent; small ruminants, 93 per cent; and dogs, 87 per cent. The response rate of the second-round surveys were cats, 79 per cent; horses, 74 per cent; rabbits, 64 per cent; cattle, 81 per cent; pigs, 93 per cent; poultry, 75 per cent; small ruminants, 93 per cent; and dogs, 93 per cent.

Demographic information

The mean age of the experts in each group was relatively consistent (table 1, 42–51 years old) across the groups. With the exception of the small ruminant group, all groups had more female than male experts. Experts were drawn from at least three different specialisms for all species; however, the small ruminant group consisted of more than 50 per cent veterinarians, whereas only 8 per cent of the horse experts were practising veterinarians. More than 50 per cent of all experts held a postgraduate degree (PhD or masters), and the majority of the remaining experts held a bachelors degree.

The number of welfare issues considered to be at least somewhat important (mean=3 or greater) ranged from 21 to 45 (table 2), and reduced the number of welfare issues to consider in the second round to 25 per cent–59 per cent of the total number of welfare issues per species.

Fleiss' kappa calculations suggested only fair to moderate agreement between experts when considering placings of all welfare issues (table 3), with highest agreement among rabbit experts and poorest for cattle. However, experts tended to agree on the most important welfare issues. For example, the percentage

Table 2 Number (per cent) of welfare issues considered in the first and second surveys by species groups; issues scoring at least mean=3 for either severity, duration or prevalence were retained into the second round

Species	Initial number of welfare issues	Number of welfare issues (%) scoring above 3 in first round		
		Severity	Duration	Prevalence
Cat*	118	43 (36.4)	38 (32.3)	30 (25.4)
Dog†	66	31 (46.9)	30 (45.5)	26 (39.4)
Horse‡	84	33 (39.3)	33 (39.3)	30 (35.7)
Rabbit§	76	21 (27.6)	23 (30.3)	22 (28.9)
Cattle¶	72	42 (58.3)	35 (48.6)	30 (41.7)
Poultry¶	81	36 (44.4)	29 (35.8)	33 (40.7)
Pig¶	80	33 (41.3)	36 (45.0)	25 (31.3)
Small ruminant¶	76	45 (59.2)	38 (50.0)	29 (38.2)

*See Rioja-Lang *et al*[13] for the full list of cat welfare issues and ranking.
†See online supplementary materials for the full list of dog welfare issues.
‡See Rioja-Lang *et al*[15] for the full list of horse welfare issues and ranking.
§See Rioja-Lang *et al*[12] for the full list of rabbit welfare issues and ranking.
¶See Rioja-Lang *et al*[14] for the full list of farm animal welfare issues and ranking.

Table 3 Fleiss' kappa (κ) for agreement between experts in the ranking of welfare issues based on severity, duration and perceived prevalence

Species	Severity	Duration	Prevalence
Cats	0.333	0.364	0.323
Dogs	0.244	0.215	0.258
Horses	0.227	0.243	0.259
Rabbits	0.400	0.424	0.473
Cattle	0.255	0.176	0.159
Poultry	0.228	0.241	0.229
Pigs	0.228	0.241	0.229
Small ruminants	0.325	0.338	0.318

of experts agreeing with the placings of the most highly ranked welfare issues was moderate to good (64 per cent–71 per cent), but agreement was only moderate to poor for overall welfare rankings (33 per cent–64 per cent agreement), with equal number of issues considered to be placed too low or too high.

Round 3, workshop

The final prioritised welfare issues by species generated in the workshop are shown in table 4a (companion animals) and table 4b (farm animals).

Experts also agreed on a list of 11 overarching areas of animal welfare concern relevant to all managed species in the UK. These themes are listed as follows, unranked:

- Lack of knowledge about the care of the species.
- Social behaviour issues.
- Problem behaviour issues.
- Breeding decisions.
- Lack of health/veterinary care.
- Poor recognition and treatment of pain.
- Delayed euthanasia.
- Inappropriate diet.
- Chronic/endemic health issues.
- Lack of appropriate environment.
- Neonatal morbidity/mortality (farm animals only).

Discussion

The Delphi process allowed the experts, firstly, to define the main welfare issues for companion and farmed animals in the UK, and secondly, to achieve a consensus on the most important welfare issues. Within the companion animal group, a number of similar issues were prioritised. Behavioural issues, particularly restrictions placed on the expression of social behaviour due to environmental or other factors, were considered important in all companion animal species, with lack of socialisation and inadequate owner knowledge of behaviour also prioritised. Obesity and issues with providing appropriate nutrition to companion animals were also common across all the species considered in this study. Delayed euthanasia for elderly or suffering pets was an important source of welfare concern for cats, dogs and horses, although reduced life expectancy was an issue for rabbits. Genetic issues and concerns about breeding for specific characteristics were specific issues for cats and dogs, and issues with training and animal use of concern for horses and dogs. Particular health concerns were identified for all species, and an inability to correctly identify pain behaviours was of general concern. In addition, owners failing to seek preventative or other veterinary advice was an issue across species. Within-species concerns about the unowned cat population and shelters were prioritised for cats, as well as the issue of animal hoarding, and for horses, there were specific concerns around the riding of horses (poorly fitting tack and rider weight in particular).

In the farmed animal species, concerns around behaviour restriction and social behaviour were raised for pigs, poultry and dairy animals, as well as the impact this may have on particular behaviours, such as tail biting and aggression in pigs. The impact of breeding decisions on the welfare of poultry was the most important welfare issue affecting both individual animals and the population. An inability to identify when animals are in pain or an inability to manage the pain associated with management procedures or practices was a common prioritised concern for all farm animals. In addition, whether there were sufficient, well-trained and knowledgeable staff to care for animals was of concern for all species. The health of farmed animals was of particular concern in general with a number of specific health concerns prioritised. As with companion animals, delayed euthanasia is also of concern for farmed animals, as well as the methods used for killing, particularly of unwanted male animals, and whether animals have access to appropriate veterinary care. The welfare of animals in transport was prioritised in poultry, sheep and beef cattle.

Lack of knowledge

An overarching theme affecting the welfare of animals was 'lack of knowledge', which included general lack of knowledge of the needs of the species, an inability to recognise and manage pain, and poor skills in animal handling and management. In discussions, lack of knowledge was considered to stem from a number of areas. For example, in some instances, the knowledge is available and known by researchers or veterinarians but is not adequately transferred and understood by animal owners or caretakers. However, in some cases, the knowledge is not available and more research is required. Finally, in some instances, both professionals and caretakers may know what the 'gold standard' of care should be; however, a range of limitations may prevent caretakers from implementing the advice (eg, economics, time, structural issues and access restrictions). These are all important considerations when looking to apply strategies to improve welfare issues.

Social behaviour

The ability of animals to exhibit appropriate social behaviours and how management of the animal

Table 4a Ranked welfare priority issues of companion animals determined using the Delphi method; where two issues are presented in the same box, this represents equal ranking given by experts

Species	Rank	Priority welfare issues	
		Severity × duration	Perceived prevalence
Cats	1	Social behaviour issues and inappropriate home environment	Neglect/hoarding
	2	Diseases of old age	Delayed euthanasia
	3	Obesity	Inherited diseases and conformation issues
	4	Not seeking veterinary care	Social behaviour issues and inappropriate home environment/inappropriate behaviours
	5	Poor pain management	Inappropriate pain management
	6	Shelter environment and long stays	Diseases of old age
	7	Unowned population management and overpopulation	Not seeking veterinary care
	8	Delayed euthanasia	Obesity
	9	Neglect/hoarding	Shelter environment and long stays
	10	Inherited diseases and conformation issues	Unowned population management and overpopulation
Dogs	1	Genetic and breeding issues	Abnormal/unwanted behaviours
	2	Lack of socialisation/habituation	Common canine health issues
	3	Obesity	Obesity
	4	Lack of knowledge of dog welfare needs by owner/carer	Lack of canine behavioural knowledge by owners and breeders
	5	Not meeting behavioural requirements	Lack of socialisation/habituation
	6	Inappropriate training methods	Lack of knowledge of dog welfare needs by owner/carer
	7	Not seeking or delayed veterinary care	Behavioural restriction
	8	Irresponsible ownership	Lack of routine vet care
	9	No regulation of establishments or service providers	Long distance travel
	10	Physical trauma	No regulation of establishments or service providers
	11		Physical trauma
Rabbits	1	Lack of socialisation /handling	Inadequacy of housing/environment
	2	Failure to vaccinate	Lack of socialisation/handling
	3	Reduced life expectancy	Inadequacy of diet (can lead to dental issues and obesity)
	4	Lack of owner/vet knowledge on basic rabbit behaviour and health (and recognition of diseases/pain)	Lack of prepurchase research by new owners
	5	Rabbits regarded as cheap/replaceable pets	Reduced life expectancy
	6	Inadequacy of diet (can lead to dental issues and obesity)	Failure to vaccinate
	7	Inadequacy of housing/environment	Rabbits regarded as cheap /replaceable pets
	8	Lack of research/education	Lack of recognition of pain behaviour
Horses	1	Delayed euthanasia decisions	Lack of biosecurity and disease surveillance
	2	Lack of recognition of pain behaviour	Delayed euthanasia decisions
	3	Large worm burdens	Lack of understanding of horse welfare needs by owner/carer
	4	Obesity	Fear/stress/injury from use in work, sport or entertainment
	5	Unsuitable diets for equine feeding behaviour	Obesity
	6	Hunger	Indiscriminate/inappropriate breeding
	7	Inability to perform normal social interactions	Poorly fitting and restrictive tack
	8	Negative affective states	Unstable social groups
	9	Overworking	Unsuitable diets for equine feeding behaviour
	10	Overweight riders	Poor weaning methods

Table 4b Ranked welfare priority issues of farmed animals determined using the Delphi method; where two issues are presented in the same box, this represents equal ranking given by experts

Species	Rank	Priority welfare issues	
		Severity × duration	Perceived prevalence
Pigs	1	Behavioural needs not met	Pain from management procedures
	2	Tail-biting, including need to dock	Tail biting, including need to dock
	3	Inadequate stockperson skills	Behavioural needs not met
	4	Delayed euthanasia	Poor housing design (floor, ventilation, maintenance and layout)
	5	Lameness	Poor general health status
	6	Poor general health status	Inadequate stockperson skills
	7	Breeding for large litters	Lameness
	8	Inadequate/unsuitable feed	Gastric ulcers and inadequate feeding
	9	Aggression	Aggression
	10	Riding behaviour	
	11	Lack of use of analgesics	

Continued

Table 4b Continued

Species	Rank	Priority welfare issues	
		Severity × duration	Perceived prevalence
Poultry	1	Consequences from breeding decisions	Consequences from breeding decisions
	2	Poor housing/management Inappropriate social grouping	Inappropriate housing conditions Inability to express natural behaviours (abnormal behaviours)
	3	Inability to express natural behaviours (abnormal behaviours)	Transportation and handling issues
	4	Neglect	Painful/uncomfortable conditions due to management/housing
	5	Lack of knowledge of poultry behaviour and stockmanship skills	Lack of knowledge of poultry behaviour and stockmanship skills
	6	Depopulation and transport issues	Painful procedures
	7	Unpreparedness for emergency	Delayed euthanasia
	8	Euthanasia methods	Physical injury from aggression
Sheep+beef cows	1	Neglect	Lack of perception of painful conditions and pain management
	2	Lameness	Lack of recognition of underlying poor health status
	3	Sheep scab Mastitis	Lack of local veterinary care Lack of staff to quickly deal with health issue
	4	Dystocia	High neonatal morbidity and mortality Lameness Chronic gastrointestinal parasites Sheep scab
	5	Inappropriate nutrition	Predation/worrying (wildlife and dog attacks)
	6	Overstocking/stocking density in housed animals	Poor dental health
	7		Lack of appropriately trained staff/contractors (eg, shearers and transporters)
Dairy cows+dairy goats	1	Inappropriate nutrition	Neonatal morbidity and mortality
	2	Neonatal morbidity and mortality	Poor pain management
	3	Poor stockmanship skills	Inappropriate nutrition
	4	Social behaviour (eg, mixing animals and aggression)	Production diseases, for example, lameness
	5	Poor pain management	Poor stockmanship skills
	6	Infectious diseases	Social behaviour (eg, mixing animals and aggression)
	7	Euthanasia techniques—specifically for killing goat kids	Infectious diseases
	8		Lack of opportunity to show species specific behaviours
	9		Euthanasia techniques—specifically for killing goat kids

may affect this were issues raised for all the species considered in this study. This ranged from inadequate socialisation and handling in companion animal species to overcrowding, mixing or social isolation in other species. Domestication has been largely focused on social species (eg, Jensen[16]) as these can be easier to manage but has also deliberately or inadvertently influenced the expression of social responses. For example, domestic dogs are more likely to show human-directed social responses than wolves (eg, 'looking back'[17] and domestication has increased social tolerance and frequency of sociopositive behaviours in farmed animals (eg, Dwyer and Lawrence and Agnvall *et al*[18 19]). However, socialisation of young animals to novel situations, objects and social companions, including humans, is an important aspect of development that can cause increased fearfulness if not conducted appropriately.[20] In addition, regular mixing with unfamiliar animals can cause high levels of damaging aggression (eg, pigs[21]), competition for resources (eg, cats)[22] and elevated stress (eg, Dwyer and Bornett[23]). Social isolation may also be a significant source of welfare concern or stress in social animals, if deprived of social companionship, which can, for example, induce separation anxiety in dogs[24] or high levels of stress in farm animals.[25] In some cases, alleviation of social behaviour induced welfare problems may require additional research (for example little is known about appropriate socialisation periods in some species), owner education or implementation of existing knowledge (eg, mixing and aggression in domestic pigs).[21]

Problem behaviours

'Problem behaviours' can include stereotypical or injurious behaviours (such as weaving in horses or tail biting in pigs), which stem from environmental or other inadequacies in the environment, or behaviours that are part of the normal behavioural repertoire of the species but are performed inappropriately (eg, Cooper and Albentosa and D'Eath *et al*[26 27]). In addition, problem behaviours may be part of the normal behaviour of the species but are not tolerated by the animal keeper (eg, scratching in cats and barking in dogs[28]) or are misinterpreted as 'naughtiness' (eg, fear behaviour in horses[29]). In all cases, these can be important welfare issues, either because they are symptomatic of an environment that does not meet the animal's needs or because of the responses made by animal owners to deal with the problem behaviour (such as tail docking in pigs, punishment or relinquishment to shelters in companion animals). Owner education in animal behaviour, particularly prepurchase, may reduce the incidence of problem behaviours, or behaviours that are perceived to be problems, in companion animals. However, those issues that derive from an impoverished environment may require more extensive interventions such as education, further research and consideration

of legislative or other policy changes to influence management change (eg, provision of enrichment to pigs, EU Council Directive 2008/120/EC).

Breeding decisions

Welfare consequences of breeding decisions were identified as important welfare issues for dogs, cats, pigs and poultry, but may play a role in welfare concerns in other species as well. For dogs and cats, but increasingly also for rabbits and horses, breeding for exaggerated conformation (largely brachycephalic features in dogs, cats and rabbits) appears to be for aesthetic reasons[30] or to meet increasingly extreme breed standards for showing. In livestock this has been predominantly to increase productivity (eg, breeding for increased meat production in poultry, larger litter sizes in pigs, increased milk production in dairy cows) which has been shown to lead to compromised welfare. For example, broiler chickens now reach slaughter weight in 6 weeks rather than 18 but this is associated with leg weakness, myopathies and severe food restriction of the parent birds.[31] The reasons that particular features of companion animals might be preferred are complex[32] and require education and potentially legislative or other changes. In some livestock sectors, there are already moves to reduce the most extreme breeding (eg, Farm Animal Welfare Council[33]) or to include fitness traits in selection indices (eg, dairy cow lameness[34]), but economic or other pressures may make this difficult to achieve.

Lack of healthcare

Poor animal health and owners not seeking veterinary assistance were of concern overall and specifically for cats, dogs, rabbits and sheep. This may stem from owners not understanding the benefits of routine veterinary care or failure to recognise poor health in their animals. In addition, some species (such as rabbits) may be considered cheap and replaceable and that veterinary care is an unnecessary expense (see discussion in Rioja-Lang *et al*[12]). Sheep studies[35 36] suggest that farmers believe that they are able to deal with animal health issues themselves and do not consider veterinary intervention useful, or only required by 'bad' farmers. The role of veterinary care in herd/flock health management and preventative care may be undervalued. For further discussion on the health priorities identified for farm animals from this study, see Rioja-Lang *et al*.[14]

Recognition and treatment of pain

Poor pain management was identified as the most important concern for pigs, sheep and beef cattle (at the population level), and the second most important issue for individual horses. Poor recognition of pain also featured in the most important welfare concerns for cats, rabbits and poultry and dairy animals, suggesting this is a widespread issue in managed animals. In companion animals, behaviour or other indicators of pain may not be recognised in animals that do not show overt pain behaviours (eg, cats), in animals that are relatively infrequently inspected (eg, rabbits) or maybe incorrectly classified as other types of response (eg, horses). In livestock species, pain may occur due to management procedures, such as tail docking, castration, tooth resection or disbudding, that are not carried out with appropriate anaesthesia or analgesia, despite extensive evidence that these procedures cause pain (eg, Rault *et al*[37]. Several studies have addressed recognition of pain in a number of species (eg, cats,[38] horses[39] and cattle[40]), but our data suggest that improved knowledge transfer may be required to animal keepers.

Delayed euthanasia

Delayed euthanasia decisions were a welfare issue across both companion and farmed species and may cause prolonged suffering where pain cannot be alleviated. The reasons why this may occur has already been discussed[13–15] for cats, farmed species and horses respectively. Reasons for delay vary from feelings of guilt or grief for the death of old or sick companion animals (and some farm animals), 'giving the animal a chance', unrealistic expectations of pain management, inexperience or an inability to recognise suffering or economic reasons. These are complex issues where veterinary education may play a role, and social science research may help to understand the underlying causes.

Diet/nutrition

Failure to feed animals adequately was identified as an issue for nearly all species, although stemming from different reasons. This ranged from obesity in dogs, cats and horses, providing an inadequate diet that does not meet animal needs or behaviour in rabbits[12] or horses,[15] and failing to provide animals with adequate feed (farm animals), either deliberately (as with sows or broiler breeders) or due to difficulties in providing adequate food (eg, winter feeding of sheep). Great advances in understanding the nutritional needs of animals have occurred, and many of these issues in companion animals stem from poor owner knowledge or understanding of animal requirements. The reasons for feeding farmed animals, usually breeding stock, in ways that do not meet their nutritional or behavioural needs are complex and may stem from production necessities, economics, lack of labour or resources or inadequate knowledge.

Environment

Across all species, animals were identified as experiencing welfare issues due to housing in environments that did not meet their behavioural needs. These can contribute to the problem behaviours or social behaviour issues discussed previously, and

contribute to ongoing or chronic health issues such as lameness in farmed animals. Some aspects of the welfare issues with poor environments have already been discussed,[12–15] and these are issues that have different root causes in different species. Domesticated dogs and cats, in particular, have shown remarkable adaptation to human environments,[41] but human management of all species is largely directed to achieving human goals, and the requirements of different species are often overlooked. The solutions to these issues can be challenging and may be constrained by economics or structural issues, but require education, research for some species and often legislation for farm animal environments to improve.

Neonatal mortality and morbidity

Issues with morbidity and mortality of neonates were specifically identified as an issue with farm animals, either through the high mortality of some species (eg, mortality of 15 per cent–25 per cent in sheep and pigs[42 43]) or through approaches towards unwanted male animals (eg, methods of euthanasia of kids and chicks, and transport of young calves). However, high mortality of young animals in companion animals can also occur with indiscriminate breeding to meet requirements for particular types of animals. A full discussion of these issues is beyond the scope of this paper, but these are complex issues requiring multifactorial approaches to provide solutions.

Conclusions

This study was successful in identifying the top priority welfare issues of eight groups of managed animals in the UK. For all species, welfare issues are multifactorial, and it can be difficult to untangle them. However, during this study, the experts from each group were successfully able to reach consensus. The final priority welfare issues contained a mix of animal-based, resource-based and management-based factors and can help to guide future research, funding and education priority decisions.

For some issues, it was undoubtedly difficult for our experts to rank the issues simply because there iares limited scientific or empirical data available on the extent of the welfare issue. There is always the possibility that very different results might ensue, depending on the panel of experts participating,[44] although our study in horses[15] showed good agreement with other studies using different types of experts. Additionally, consensus methodologies make assumptions on the quality of the expert panel's decisions.[45] However, in studies where empirical evidence is unavailable, the Delphi method does provide a framework with which to work, and the results should be interpreted with the acknowledgement of the limitations. By inviting stakeholders from a range of professional and academic disciplines to participate, there is more likely to be a balance of inevitable discipline-specific biases.[5] In addition, the average response rate for the present study was 82 per cent. This high response rate provides us with a good degree of confidence that we have covered a broad spectrum of expert opinion and that the results of the present study are reliable.

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Acknowledgements The authors thank the 144 animal welfare experts who participated in the larger Delphi study. This study was funded by the Animal Welfare Foundation (AWF). AWF is a fundraising and grant giving charity (charity number 287118) directed by veterinary professions, which uses veterinary knowledge to improve the welfare of animals through science, education and debate. More information can be found online (www.animalwelfarefoundation.org.uk).

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval All research in this study was approved by the University of Edinburgh's Human Ethics Review Committee.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. All relevant data have been included in the article, as supplementary material or in referenced papers given in footnotes to the tables.

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References

1 Harrison R. Animal Machines: An exposé of "factory farming" and its danger to the public. New York: Ballantines Books Inc, 1964.
2 Buckland EL, Whiting MC, Abeyesinghe SM, *et al*. A survey of stakeholders' opinions on the priority issues affecting the welfare of companion dogs in Great Britain. *Anim Welf* 2013;22:239–53.
3 Kirkwood JK, Sainsbury AW, Bennett PM. The welfare of free-living wild animals: methods of assessment. *Anim Welf* 1994;3:257–73.
4 Farm Animal Welfare Council [FAWC]. Farm animal welfare in Great Britain: past, present and future, 2009. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/319292/Farm_Animal_Welfare_in_Great_Britain_-_Past__Present_and_Future.pdf [Accessed 7 Feb 2020].
5 Buckland EL, Corr SA, Abeyesinghe SM, *et al*. Prioritisation of companion dog welfare issues using expert consensus. *Animal Welfare* 2014;23:39–46.
6 Yeates JW, Main DCJ. Veterinary surgeons' opinions on dog welfare issues. *J Small Anim Pract* 2011;52:464–8.
7 Phythian CJ, Michalopoulou E, Jones PH, *et al*. Validating indicators of sheep welfare through a consensus of expert opinion. *Animal* 2011;5:943–52.
8 Horseman SV, Buller H, Mullan S, *et al*. Current welfare problems facing horses in Great Britain as identified by equine stakeholders. *PLoS One* 2016;11:e0160269.
9 Whay HR, Main DCJ, Green LE, *et al*. Animal-Based measures for the assessment of welfare state of dairy cattle, pigs and laying hens: consensus of expert opinion. *Anim Welf* 2003;12:205–17.
10 Bracke MBM, Metz JHM, Spruijt BM, *et al*. Decision support system for overall welfare assessment in pregnant sows B: validation by expert opinion. *J Anim Sci* 2002;80:1835–45.
11 Capdeville J, Veissier I. A method of assessing welfare in loose housed dairy cows at farm level, focussing on animal observations. *Acta Agric Scand Section A – Animal Science* 2011;51:62–8.
12 Rioja-Lang F, Bacon H, Connor M, *et al*. Rabbit welfare: determining priority welfare issues for PET rabbits using a modified Delphi method. *Vet Rec Open* 2019;6:e000363.
13 Rioja-Lang F, Bacon H, Connor M, *et al*. Determining priority welfare issues for cats in the United Kingdom using expert consensus. *Vet Rec Open* 2019;6:e000365.
14 Rioja-Lang FC, Connor M, Bacon HJ, *et al*. Prioritization of farm animal welfare issues using expert consensus. *Front Vet Sci* 2019;6:495.
15 Rioja-Lang FC, Connor M, Bacon H, *et al*. Determining a welfare prioritization for horses using a Delphi method. *Animals* 2020;10. doi:10.3390/ani10040647
16 Jensen P. Behavior genetics and the domestication of animals. *Annu Rev Anim Biosci* 2014;2:85–104.
17 Marshall-Pescini S, Rao A, Virányi Z, *et al*. The role of domestication and experience in 'looking back' towards humans in an unsolvable task. *Sci Rep* 2017;7:46636.

18 Dwyer CM, Lawrence AB. A review of the behavioural and physiological adaptations of Hill and lowland breeds of sheep that favour lamb survival. *Appl Anim Behav Sci* 2005;92:235–60.
19 Agnvall B, Bélteky J, Katajamaa R, *et al*. Is evolution of domestication driven by tameness? a selective review with focus on chickens. *Appl Anim Behav Sci* 2018;205:227–33.
20 Pierantoni L, Albertini M, Pirrone F. Prevalence of owner-reported behaviours in dogs separated from the litter at two different ages. *Vet Rec* 2011;169:468.
21 Turner SP, Horgan GW, Edwards SA. Effect of social group size on aggressive behaviour between unacquainted domestic pigs. *Appl Anim Behav Sci* 2001;74:203–15.
22 Amat M, Camps T, Manteca X. Stress in owned cats: behavioural changes and welfare implications. *J Feline Med Surg* 2016;18:577–86.
23 Dwyer CM, Bornett HLI. Chronic stress in sheep: assessment tools and their use under different management conditions. *Anim Welf* 2004;13:293–304.
24 van Rooy D, Arnott ER, Thomson PC, *et al*. Using an owner-based questionnaire to phenotype dogs with separation-related distress: do owners know what their dogs do when they are absent? *J Vet Behav* 2018;23:58–65.
25 Siebert K, Langbein J, Schön P-C, *et al*. Degree of social isolation affects behavioural and vocal response patterns in dwarf goats (*Capra hircus*). *Appl Anim Behav Sci* 2011;131:53–62.
26 Cooper JJ, Albentosa MJ. Behavioural adaptation in the domestic horse: potential role of apparently abnormal responses including stereotypic behaviour. *Livest. Prod Sci* 2005;92:177–82.
27 D'Eath RB, Arnott G, Turner SP, *et al*. Injurious tail biting in pigs: how can it be controlled in existing systems without tail docking? *Animal* 2014;8:1479–97.
28 Bradshaw J. Normal feline behaviour: and why problem behaviours develop. *J Feline Med Surg* 2018;20:411–21.
29 Hothersall B, Casey R. Undesired behaviour in horses: a review of their development, prevention, management and association with welfare. *Equine Vet Educ* 2012;24:479–85.
30 Packer RMA, Murphy D, Farnworth MJ. Purchasing popular purebreds: investigating the influence of breed-type on the pre-purchase motivations and behaviour of dog owners. *Anim Welf* 2017;26:191–201.
31 Rauw WM, Kanis E, Noordhuizen-Stassen EN, *et al*. Undesirable side effects of selection for high production efficiency in farm animals: a review. *Livest. Prod Sci* 1998;56:15–33.
32 Serpell JA. How happy is your PET? the problem of subjectivity in the assessment of companion animal welfare. *Anim Welf* 2019;28:57–66.
33 Farm Animal Welfare Council [FAWC]. Opinion on the welfare implications of breeding and breeding technologies in commercial livestock agriculture, 2012. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/324658/FAWC_opinion_on_the_welfare_implications_of_breeding_and_breeding_technologies_in_commercial_livestock_agriculture.pdf [Accessed 23 Mar 2020].
34 Heringstad B, Egger-Danner C, Charfeddine N, *et al*. Invited review: genetics and claw health: opportunities to enhance claw health by genetic selection. *J Dairy Sci* 2018;101:4801–21.
35 Munoz CA, Coleman GJ, Hemsworth PH, *et al*. Positive attitudes, positive outcomes: the relationship between farmer attitudes, management behaviour and sheep welfare. *PLoS One* 2019;14:e0220455.
36 Kaler J, Green LE. Sheep farmer opinions on the current and future role of veterinarians in flock health management on sheep farms: a qualitative study. *Prev Vet Med* 2013;112:370–7.
37 Rault J-L, Lay DC, Marchant-Forde JN. Castration induced pain in pigs and other livestock. *Appl Anim Behav Sci* 2011;135:214–25.
38 Steagall PV, Monteiro BP. Acute pain in cats: recent advances in clinical assessment. *J Feline Med Surg* 2019;21:25–34.
39 van Loon JPAM, Van Dierendonck MC. Objective pain assessment in horses (2014-2018). *Vet J* 2018;242:1–7.
40 Mandel R, Harazy H, Gygax L, *et al*. Short communication: detection of lameness in dairy cows using a grooming device. *J Dairy Sci* 2018;101:1511–7.
41 Newsome TM, Fleming PJS, Dickman CR, *et al*. Making a new dog? *Bioscience* 2017;67:374–81.
42 Dwyer CM, Conington J, Corbiere F, *et al*. Invited review: improving neonatal survival in small ruminants: science into practice. *Animal* 2016;10:449–59.
43 Edwards SA, Baxter EM. Piglet mortality: causes and prevention. In: Farmer C, ed. The gestating and lactating sow. Wageningen Academic Publishers, 2015: 253–78.
44 Bennett RM, Broom DM, Henson SJ, *et al*. Assessment of the impact of government animal welfare policy on farm animal welfare in the UK. *Anim Welf* 2004;13:1–11.
45 Fink A, Kosecoff J, Chassin M, *et al*. Consensus methods: characteristics and guidelines for use. *Am J Public Health* 1984;74:979–83.